Does right thoracotomy increase the risk of mitral valve reoperation?

Lars G. Svensson, MD, PhD,[a] A. Marc Gillinov, MD,[a] Eugene H. Blackstone, MD,[a,b] Penny L. Houghtaling, MS,[b] Kyung-Hwan Kim, MD,[a] Gösta B. Pettersson, MD, PhD,[a] Nicholas G. Smedira, MD,[a] Michael K. Banbury, MD,[a] and Bruce W. Lytle, MD[a]

Supplemental material is available online.

Objective: The study objective was to determine whether a right thoracotomy approach increases the risk of mitral valve reoperation.

Methods: Between January of 1993 and January of 2004, 2469 patients with mitral valve disease underwent 2570 reoperations (1508 replacements, 1062 repairs). The approach was median sternotomy in 2444 patients, right thoracotomy in 80 patients, and other in 46 patients. Multivariable logistic regression was used to identify factors associated with median sternotomy versus right thoracotomy, mitral valve repair versus replacement, hospital death, and stroke. Factors favoring median sternotomy ($P < .03$) included coronary artery bypass grafting (30% vs 2%), aortic valve replacement (39% vs 2%), tricuspid valve repair (27% vs 13%), fewer previous cardiac operations, more recent reoperation, and no prior left internal thoracic artery graft. These factors were used to construct a propensity score for risk-adjusting outcomes.

Results: Hospital mortality was 6.7% (163/2444) for the median sternotomy approach and 6.3% (5/80) for the thoracotomy approach ($P = .9$). Risk factors ($P < .04$) included earlier surgery date, higher New York Heart Association class, emergency operation, multiple reoperations, and mitral valve replacement. Stroke occurred in 66 patients (2.7%) who underwent a median sternotomy and in 6 patients (7.5%) who underwent a thoracotomy ($P = .006$). Mitral valve replacement (vs repair) was more common in those receiving a thoracotomy ($P < .04$).

Conclusions: Compared with median sternotomy, right thoracotomy is associated with a higher occurrence of stroke and less frequent mitral valve repair. Specific strategies for conducting the operation should be used to reduce the risk of stroke when right thoracotomy is used for mitral valve reoperation. In most instances, repeat median sternotomy, with its better exposure and greater latitude for concomitant procedures, is preferred.

From the Department of Thoracic and Cardiovascular Surgery[a] and Department of Quantitative Health Sciences,[b] Cleveland Clinic, Cleveland, Ohio.

Received for publication March 10, 2006; revisions received April 10, 2007; accepted for publication April 16, 2007.

Address for reprints: Lars G. Svensson, MD, PhD, Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic, 9500 Euclid Avenue/Desk F24, Cleveland, OH 44195 (E-mail: svenssl@ccf.org).

J Thorac Cardiovasc Surg 2007;134:677-82

0022-5223/$32.00

doi:10.1016/j.jtcvs.2007.04.052

A variety of reoperative approaches have been used for mitral valve surgery after previous cardiac surgery, including repeat median sternotomy, right thoracotomy, minimally invasive approaches, and robotic methods.[1-11] Many favor the use of a right thoracotomy, citing reduced risk of damage to patent bypass grafts and need for less dissection to expose the mitral valve.[3,4,6,8] However, the right thoracotomy approach raises specific technical issues, including adequacy of mitral valve exposure and myocardial protection, and need for peripheral cannulation for cardiopulmonary bypass (CPB). Although median sternotomy has generally been our favored approach for mitral valve reoperation, some surgeons in our group have periodically used a right thoracotomy. The objective of this study was to determine whether a right thoracotomy increases the risk of mitral reoperation compared with a median sternotomy.

Abbreviations and Acronyms
CABG = coronary artery bypass grafting
CL = confidence limit
CPB = cardiopulmonary bypass

Materials and Methods

Patients

From January 1993 to January 2004, 2570 reoperations were performed at the Cleveland Clinic in 2469 adults (aged ≥ 18 years) with mitral valve disease. The initial procedure was any cardiac operation performed through a median sternotomy; 483 patients had previously undergone a mitral valve procedure. The reoperative approach to the mitral valve was through a repeat median sternotomy in 2444 patients (95%), right thoracotomy in 80 patients (3.1%), and other (minimally invasive approaches) in 46 patients (1.9%). Because minimally invasive incisions were developed only recently, encompass a variety of different approaches, and are used infrequently, patients with this incision were excluded from the analyses. At reoperation, 1508 patients underwent mitral valve replacement, and 1062 patients underwent mitral valve repair. The mean age at reoperation was 64 ± 12 years, and 55% were men (Table 1).

Operative Approach

Repeat median sternotomy was performed using an oscillating saw; in most instances, femoral vessels were exposed in case urgent institution of CPB became necessary. CPB was established using central cannulation, and cardiac arrest was achieved with aortic clamping and antegrade and retrograde cardioplegia. The mitral valve was accessed either through the left atrium or an extended transseptal incision.

Before the thoracotomy, the extent of descending aortic arteriosclerosis was assessed by transesophageal echocardiography; in the case of severe descending aortic arteriosclerosis, a median sternotomy approach was favored. The right thoracotomy approach included single-lung ventilation and entry into the chest through the fourth or fifth or intercostal space. Femoral cannulation was used for CPB. In 73 of 80 patients (91%), the operation was performed with systemic hypothermia and ventricular fibrillation; in the other 7 patients, the aorta was clamped and cardioplegia was administered. The mitral valve was accessed through a left atriotomy. After the mitral valve procedure, the lungs were inflated and the heart was filled to facilitate deairing at completion of left atrial closure. In addition, a vent was placed across the mitral valve and, combined with an aortic root vent, used to complete deairing before weaning from CPB. Deairing was monitored by transesophageal echocardiography. Seven patients (8.8%) who received a thoracotomy and 71 patients (2.9%) who received a sternotomy had hypothermic circulatory arrest.

End Points

End points included stroke, hospital mortality, and mitral valve repair versus replacement. *Stroke* was defined according to The Society of Thoracic Surgeons database: permanent stroke—central neurologic deficit persisting more than 72 hours after operation. *Hospital mortality* was defined as 30-day and in-hospital death. *Mitral valve repair versus replacement* applied to the type of mitral valve procedure performed in a subgroup of patients without previous mitral valve replacement.

Data Analysis

Operative approach and propensity matching. By multivariable logistic regression analysis, factors identified as favoring a repeat median sternotomy rather than a right thoracotomy at reoperation included the need for concomitant coronary artery bypass grafting (CABG) (39% vs 1%), aortic valve replacement (30% vs 0%), tricuspid valve repair (27% vs 15%), fewer previous cardiac operations, more severe heart failure, more recent reoperative date, no prior left internal thoracic artery graft, and 3-system coronary artery disease (parsimonious model). Previous mitral valve repair or replacement, previous aortic valve replacement, chronic obstructive pulmonary disease, and emergency operation were not associated with the operative approach. Circulatory arrest data were included in the parsimonious logistic regression model.

To generate a propensity score for each patient, we first augmented the parsimonious logistic model with variables representing every category of potential risk factor listed in Appendix E1, 53 in total (C = .92).[12,13] Then, with this augmented model, a propensity score for operative approach was generated for each patient for use in thorough risk adjustment.

Outcomes and operative approach. The association of operative approach with hospital mortality, perioperative stroke, and mitral valve repair versus replacement, adjusted for risk factors and propensity score, was quantified by multivariable logistic regression analysis. Selection of other risk factors used automated stepwise selection and bootstrap bagging, using 100 bootstrap samples.[14] Variables significant at a P value of .05 or less and appearing in at least 40% of the bootstrap analyses were identified as risk factors. A generalized estimating equation with logit link was used for final parameter estimates to compensate for fixed variables in patients who underwent multiple mitral valve reoperations.[15]

Presentation

Means are accompanied by their standard deviation; however, when distribution of values was skewed, the median and 15th and 85th percentiles are given. Percentages are accompanied by 68% confidence limits (CLs) (equivalent to ±1 standard error). Except for interpretable binary variables, logistic coefficients and their standard error are presented rather than odds ratios, in part because the use of linearizing transformations for continuous variables renders odds ratios difficult to interpret. Odds ratios are shown for dichotomous variables.

Results

Hospital Mortality

Operative approach was not associated with hospital mortality. There were 168 hospital deaths (6.6%; CL 6.1%–7.1%): 163 (6.7%; CL 6.1%–7.1%) in the median sternotomy group and 5 (6.3%; CL 3.6%–10.2%) in the right thoracotomy group (P = .9). Risk factors included earlier date of operation, higher New York Heart Association functional class, emergency reopera-